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Proposed Re-evaluation Decision

Trifluralin

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Overview

What Is the Proposed Re-evaluation Decision?

After a re-evaluation of the herbicide trifluralin, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration for the sale and use of products containing trifluralin in Canada.

An evaluation of available scientific information found that products containing trifluralin do not present unacceptable risks to human health or the environment when used according to label directions. As a condition of the continued registration of trifluralin uses, new risk-reduction measures are proposed to be included on the labels of all products.

The PMRA has not made a final determination of the status of trifluralin under the federal Toxic Substances Management Policy at this time. Additional field data addressing bioaccumulation are required to complete this assessment.

This proposal affects all end-use products containing trifluralin registered in Canada. Once the final re-evaluation decision is made, the registrants will be instructed on how to address any new requirements.

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for trifluralin and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of trifluralin.

The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (please see contact information on the cover page of this document).

What Did Health Canada Consider When Making a Re-evaluation Decision?

The PMRA's pesticide re-evaluation program considered potential risks, as well as value, of pesticide products to ensure they met modern standards established to protect human health and the environment. Regulatory Directive DIR2001-03, *PMRA Re-evaluation Program*, presents the details of the re-evaluation activities and program structure.

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[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

Trifluralin, one of the active ingredients in the current re-evaluation cycle, has been re-evaluated under Re-evaluation Program 1. This program relies as much as possible on foreign reviews, typically United States Environmental Protection Agency (USEPA) Reregistration Eligibility Decision (RED) documents. For products to be re-evaluated under Program 1, the foreign review must meet the following conditions:

- it covers the main science areas, such as human health and the environment, that are necessary for Canadian re-evaluation decisions;
- it addresses the active ingredient and the main formulation types registered in Canada; and
- it is relevant to registered Canadian uses.

Given the outcome of foreign reviews and a review of the chemistry of Canadian products, the PMRA will propose a re-evaluation decision and appropriate risk-reduction measures for Canadian uses of an active ingredient. In this decision, the PMRA takes into account the Canadian use pattern and issues (e.g. the federal Toxic Substances Management Policy [TSMP]).

The USEPA conducted a re-evaluation of trifluralin and conclusions of this re-evaluation are published in a 1996 RED and a 2004 Tolerance Reassessment Eligibility Decision (TRED). Based on health and environmental risk assessments, the USEPA concluded that trifluralin was eligible for reregistration provided risk-reduction measures were adopted. The PMRA compared the American and Canadian use patterns and found the USEPA assessments were an adequate basis for the proposed Canadian re-evaluation decision with respect to human health. The PMRA's conclusions with respect to the environment and Canadian issues (TSMP) were based on an environmental assessment performed by the PMRA.

For more details on the information presented in this overview, please refer to the Science Evaluation in this consultation document.

What Is Trifluralin?

Trifluralin is a pre-emergent soil herbicide used to control annual grasses and broadleaved weeds. It is registered for use in Canada on ornamentals, shelterbelts, terrestrial food/feed crops, oil seed and fibre production crops. Trifluralin is formulated as granules or a liquid, and is also impregnated into landscape fabric. Trifluralin may be applied by farmers and professional applicators using air for granules only (applied dry), and ground equipment, or as landscape fabric just below the soil surface. Homeowners can apply trifluralin by hand using the shaker can provided.

Health Considerations

Can Approved Uses of Trifluralin Affect Human Health?

Trifluralin is unlikely to affect your health when used according to the revised label directions.

People could be exposed to trifluralin by consuming food and water, by working as a mixer/loader/applicator or by entering treated sites. The PMRA considers two key factors when assessing health risks: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only uses for which exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration.

The USEPA concluded that trifluralin was unlikely to affect human health provided that risk-reduction measures were implemented. These conclusions apply to the Canadian situation, and equivalent risk-reduction measures are required.

Maximum Residue Limits

The *Food and Drugs Act* prohibits the sale of food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for *Food and Drugs Act* purposes through the evaluation of scientific data under the *Pest Control Products Act*. Each MRL value defines the maximum concentration in parts per million (ppm) of a pesticide allowed in or on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Trifluralin is currently registered in Canada for use on a variety of crops. Trifluralin could be used in other countries on crops that are imported into Canada. Where no specific maximum residue limit (MRL) for a pest control product has been established in the Food and Drug Regulations, subsection B.15.002(1) applies. This requires that residues do not exceed 0.1 ppm and has been considered a general MRL for enforcement purposes. An MRL for trifluralin is established for carrots at 0.5 ppm. Residues of trifluralin in all other agricultural commodities, including those approved for treatment in Canada are regulated by subsection B.15.002(1). However, changes to this general MRL may be implemented in the future, as indicated in Discussion Document DIS2006-01, *Revocation of 0.1 ppm as a General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)]*. If and when the general MRL is revoked, a transition strategy will be established to allow permanent MRLs to be set.

Environmental Considerations

What Happens When Trifluralin is Introduced Into the Environment?

Trifluralin poses a potential risk to terrestrial and aquatic plants and freshwater and estuarine/marine biota; therefore, additional risk-reduction measures need to be observed.

When trifluralin is released into the environment, it will have a tendency to sorb to soil as well as particulate matter in the surface water. It will also volatilize into the air and has the potential for long-range transport as it has been detected in remote regions of Canada, including the Arctic. Trifluralin is moderately persistent to persistent in terrestrial environments but is non-persistent in water and air. Trifluralin is not mobile in soil and remains primarily in the top surface layers.

According to a refined risk assessment, trifluralin would not pose a risk to terrestrial biota. However, trifluralin does present a risk to aquatic organisms like invertebrates, fish, plants, algae and amphibians. To reduce the effects of trifluralin in the environment, buffer zones and precautionary label statements are required.

Trifluralin meets three of four criteria for inclusion as a TSMP Track 1 substance (persistence, anthropogenic and *Canadian Environmental Protection Act* toxic [CEPA-toxic]). However, the PMRA has not made a final determination of the status of trifluralin under the TSMP at this time due to uncertainties with the fourth criteria, bioacccumulation. Additional field data addressing bioaccumulation, especially in the upper food chains, are required to complete this assessment.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law. As a result of the re-evaluation of trifluralin, the PMRA is proposing further risk-reduction measures for product labels.

Human Health

- Additional protective equipment to protect mixers/loaders/applicators
- A restricted-entry interval to protect workers entering treated sites
- Skin sensitizer indication

Environment

- Additional advisory statements to protect non-target species
- Buffer zones for aquatic and terrestrial habitats

What Additional Scientific Information Is Required?

Data are required as a condition of continued registration under section 12 of the *Pest Control Products Act*. The registrant is required to provide the following data in order to make a final determination of the status of trifluralin under the TSMP.

- Field data addressing the bioaccumulation of trifluralin in biota inhabiting the areas of use

- Analysis of air, water and biota in remote areas (e.g. the Arctic) to provide additional and more recent data on long-range transport and bioaccumulation of trifluralin

Next Steps

Before making a final re-evaluation decision on trifluralin, the PMRA will consider all comments received from the public in response to this consultation document. The PMRA will then publish a Re-evaluation Decision[2] that will include the decision, the reasons for it, a summary of comments received on the proposed decision and the PMRA's response to these comments.

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[2] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Science Evaluation

1.0 Introduction

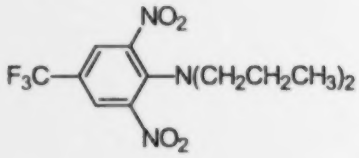
Trifluralin, a soil herbicide, may be applied by farm workers once per year from early spring to late fall using ground or aerial equipment. It is then incorporated into the soil using mechanical means. In residential settings, trifluralin may be applied by homeowners to ornamental gardens.

Following the re-evaluation announcement for trifluralin, the registrant of the technical grade active ingredient in Canada indicated its intention to provide continued support for all uses included on the labels of commercial and domestic end-use products in Canada.

The PMRA used recent assessments of trifluralin from the United States Environmental Protection Agency (USEPA). The USEPA Reregistration Eligibility Decision (RED) document for trifluralin, dated 1996, the USEPA TRED (2004) as well as other information on the regulatory status of trifluralin in the United States can be found on the USEPA Pesticide Reregistration Status page at www.epa.gov/pesticides/reregistration/status.htm. Other information considered for the environmental assessment of trifluralin is listed under References.

2.0 The Technical Grade Active Ingredient, Its Properties and Uses

2.1 Identity of the Technical Grade Active Ingredient

Common name	Trifluralin
Function	Herbicide
Chemical family	Dinitroaniline herbicide
Chemical name	
1 **International Union of Pure and Applied Chemistry (IUPAC)**	α,α,α-trifluoro-2,6-dinitro-N,N-di-n-propyl-p-toluidine
2 **Chemistry Abstracts Service (CAS)**	2,6-dinitro-N,N-di-n-propyl-4-(trifluoromethyl)benzenamine
CAS Registry Number	578064
Molecular formula	$C_{13}H_{16}F_3N_3O_4$
Structural formula	
Molecular weight	335.3

Purity of the technical grade active ingredient	96.6% NS (limits: 95–98)	98.0% NS (limits: 95–99.9)	96.3% NS (limits: 93.49–99)
Registration Number	18602	18608	20434

Based on the manufacturing process, N-nitroso-di-n-propylamine (NDPA) is expected to be present in all trifluralin products but is not expected to exceed the regulation limit of 1.0 ppm. No other impurities of toxicological concern as identified in Section 2.13.4 of DIR98-04 or TSMP Track 1 substances as identified in Appendix II of DIR99-03 are expected to be present in the starting materials used to manufacture the product, nor are they expected to be formed during the manufacturing process.

2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Property	Result
Vapour pressure	6.1 mPa (25°C)
Henry's law constant	15 $Pa \cdot m^3 \cdot mol^{-1}$
UV-visible spectrum	λ_{max} = 400 nm
Solubility in water	**pH** **solubility (mg/L)** 5 0.184 7 0.221 9 0.189
n-Octanol–water partition coefficient	log K_{ow} = 4.83 (20°C)

2.3 Comparison of Use Patterns in Canada and the United States

Trifluralin is a pre-emergent soil herbicide used to control annual grasses and broadleaved weeds. Trifluralin acts by inhibiting root development and is formulated as granules or a liquid, and is also impregnated into landscape fabric. In Canada, trifluralin is currently registered to control weeds for the following uses:

- ornamentals (established flowers, roses, trees, shrubs and ground cover, woody and perennial ornamental planting and nursery stock)
- shelterbelts (American elm, caragan, green ash, Scotch pine, Siberian elm)
- terrestrial food/feed crops (fall seeded wheat, rye and triticale grown in rotation with tobacco, rutabaga, forage legumes, Saskatoon berries, carrots, peppers, strawberries, tomatoes, summer fallow, followed by spring or durum wheat, white turnips, forage kale, forage rape, white lupins and first year apple, apricot, cherry, peach, plum and pear trees, Brussels sprouts, cauliflower, crambe, sainfoin and sweet clover, alfalfa, beans, fababeans, snapbeans, peas, soybeans, sunflowers, lentils, barley and wheat, asparagus, broccoli and cabbage)

- oil seed and fibre production crops (canola/rapeseed, triazine tolerant canola/rapeseed, flax, mustard and safflower)

Some of the uses above have regional restrictions in Canada.

Based on the comparison of formulation types, use sites, guarantees, application methods and application rates for trifluralin, the following were observed.

- Canadian formulations of end-use products, application methods and most use sites are among those registered in the United States, except with relation to rutabaga, strawberries and Saskatoon berries.

- The American use pattern is more extensive with the following additional uses:

    - Agricultural crops—almonds, apricots, celery, cherries, collards, corn, cotton, cucumbers, dill, eggplant, endive, escarole, grapefruit, grapes, hay, hops, lemons, lettuce, limes, lots/farmsteads, cantaloupe, honeydew melons, mint, nectarines, oats, okra, onions, oranges, parsley, pasture/rangeland, peaches, peanuts, pecans, plums/prunes, potatoes, pumpkins, sorghum, sugar beets, sugarcane, sweet corn, tangelos, tangerines, watermelon, turf, tobacco and pomegranates

    - Non-crop areas—paved areas, recreational areas/lawns and industrial sites

Based on this comparison of American and Canadian use patterns, it was concluded that the USEPA RED and the related documents for trifluralin are an adequate basis for the re-evaluation of Canadian uses of trifluralin with respect to human health. The PMRA conducted a separate assessment for trifluralin with respect to the environment and Canadian issues (TSMP).

All current uses are being supported by the registrant; therefore, they were all considered in the re-evaluation of trifluralin. Appendix I lists all trifluralin products that are registered under the authority of the *Pest Control Products Act* as of 1 December 2007.

3.0 Impact on Human Health

In its 1996 RED, the USEPA concluded that the use of products containing trifluralin would not pose unreasonable risks or adverse effects to humans or the environment if used according to the amended product labels. After the RED, the USEPA published a TRED in 2004 that includes an aggregate risk assessment that met the *Food Quality Protection Act* requirements. This assessment, although based on the same toxicological database as the RED, revised the endpoint for carcinogenic risk and certain routes and durations of exposure. Overall, no harm to the American general population, infants or children was expected from aggregate exposure to residues of trifluralin.

3.1 Human Health

Toxicology studies in laboratory animals describe potential health effects resulting from various levels of exposure to a chemical and identify dose levels at which no effects are observed. Unless there is evidence to the contrary, it is assumed that effects observed in animals are relevant to humans and that humans are more sensitive to effects of a chemical than the most sensitive animal species.

In Canada, exposure to trifluralin may occur through consumption of food and water, while working as a mixer/loader/applicator or by entering treated sites. When assessing health risks, the PMRA considers two key factors: the levels where no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers).

3.1.1 Occupational Exposure and Risk Assessment

Occupational risk is estimated by comparing potential exposures with the most relevant endpoint from toxicology studies to calculate a margin of exposure (MOE). This is compared to a target MOE incorporating safety factors protective of the most sensitive human population. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be required.

Where evidence of carcinogenicity is identified for the active ingredient, a cancer potency factor (Q_1*) is generated and used to estimate cancer risk. The product of the expected exposure and the cancer potency factor (Q_1*) estimates the lifetime cancer risk as a probability. A lifetime cancer risk in the range of 1 in 10^{-5} to 1 in 10^{-6} in worker population groups is generally considered acceptable. The USEPA's toxicological endpoints for assessing risk from occupational exposure are summarized in Appendix II.

3.1.1.1 Mixer/Loader/Applicator Exposure and Risk

Workers can be exposed to trifluralin through mixing, loading or applying the pesticide and when entering a treated site to conduct activities such as scouting or handling of treated crops.

In the RED, the USEPA assessed occupational exposure to trifluralin for the following scenarios, which are relevant to the Canadian situation:

- mixing/loading the liquid formulation
- loading granulars for ground and aerial application
- groundboom application of liquids
- granular (6 and 8) row-planter application
- granular spreader-cultivator application

The USEPA considered that workers would be exposed for short-term durations (one day) and that the custom/professional applicator would be exposed for intermediate-term durations (10 days). Cancer risk via dermal and inhalation routes was assessed for farm workers and

custom applicators, based on maximum trifluralin application rates of 2.24 kg a.i./ha and maximum area treated per day (325 ha by air and 32.5 by ground).

Handler exposure was estimated using the Pesticide Handlers Exposure Database (PHED), assuming farm workers wore long pants, shoes, socks, a long-sleeved shirt and gloves. Exposure to workers using 6- and 8-row planter equipment was estimated using a study involving applicators in an enclosed cab, wearing coveralls over a long-sleeved shirt and long pants, and chemical-resistant gloves.

Carcinogenic risk ranged from 1.2×10^{-5} for custom applicators mixing and loading liquids to 5.0×10^{-8} for those applying trifluralin granules using a mounted spreader cultivator. Risk to the farm worker was one tenth the reported risk for custom applicators. The USEPA reported that the cancer risk was not of concern for all occupational exposure scenarios.

The RED addressed potential exposure scenarios associated with the Canadian uses of products containing trifluralin, and conclusions derived from the RED apply to the Canadian situation.

The USEPA conducted further risk assessments in 2004 for the purpose of reassessing tolerances. The assessments were based on the same toxicological database as in the RED, with the following revisions to the endpoints:

- short-term inhalation: no observed adverse effect level (NOAEL) of 81 mg/kg bw/day
- intermediate exposure (oral, dermal and inhalation): NOAEL of 10 mg/kg bw/day (dermal absorption 3% and inhalation absorption 100%)
- cancer: Q_1^* of 5.79×10^{-3}

Occupational short- and intermediate-term margins of exposure (MOEs) ranged from 208 to 135 000 when using the USEPA inhalation and dermal endpoints selected in 2004 in conjunction with daily inhalation and dermal exposure estimates derived from the PHED database. All MOEs are acceptable. The PMRA requires that all commercial product labels include the following to further protect workers: a long-sleeved shirt, long pants, shoes and chemical-resistant gloves during mixing and loading. Coveralls are also required for aerial mixers/loaders.

3.1.1.2 Postapplication Exposure and Risk

Although no quantitative postapplication exposure assessment was conducted in the RED, the USEPA did not expect there to be a concern based on the low risk associated with handler exposure, the low dermal absorption value and the fact that postapplication inhalation exposure was not significant for outdoor scenarios. A 12-hour restricted-entry interval (REI) was required based on the United States Worker Protection Standard.

The RED adequately addressed potential occupational postapplication exposure scenarios associated with the Canadian uses of trifluralin. In Canada, trifluralin end-use products are applied once per growing season, typically in the spring pre-emergent to the weeds and at least three weeks prior to seeding or transplanting agricultural crops. The typical earliest re-entry to treated fields by workers would be for seeding or transplanting. Following that, re-entry would

be for scouting purposes and harvesting. Application to fields requires incorporation into the soil and, based on the use pattern, early re-entry for cultural practices is not expected. Postapplication exposure to trifluralin residues would then likely be through contact with treated soil.

An REI of 12 hours for all trifluralin agricultural use products is considered applicable to the Canadian situation. Proposed label amendments are listed in Appendix XIII.

3.1.2 Non-Occupational Exposure and Risk Assessment

In the 2004 TRED, non-occupational and dietary sources of exposure to trifluralin were considered in the reassessment of tolerances.

3.1.2.1 Residential Exposure

Residential risk is estimated using the MOE approach described in Section 3.1.1.1. The toxicological endpoints selected by the USEPA for assessment of risk from residential exposure are summarized in Appendix II.

In the United States, trifluralin is registered for use on vegetable and ornamental gardens, turf and lawns. Risks to adult handlers and to adults and children from postapplication exposure (including incidental ingestion by toddlers) were assessed in the 2004 TRED.

Residential Handlers
The following two scenarios assessed by the USEPA were relevant to the Canadian situation:

- loading/applying granulars using a spoon, measuring scoop, shaker can, or by hand
- applying trifluralin-impregnated fabric squares to soil

No short-term dermal endpoint was identified for trifluralin. A NOAEL of 81 mg/kg bw/day based on a 30-day inhalation study in rats was used to assess non-cancer inhalation risks. Carcinogenic risk took into consideration exposure to trifluralin through the dermal and inhalation routes.

The 1997 USEPA *Standard Operating Procedures (SOPs) for Residential Exposure Assessments* was used along with unit exposure values from surrogate data to estimate potential exposure.

Short-term inhalation MOEs ranged from 2.7×10^5 to 1.4×10^7 (target MOE = 100) for homeowners applying granules from a shaker can and are considered acceptable.

As a homeowner in the United States could apply trifluralin to gardens and lawns, a combined cancer risk for these scenarios was calculated. The total carcinogenic risk to the residential handler from applying trifluralin by hand to ornamental and vegetable gardens and to turf was 1.68×10^{-8}, which is below the USEPA's level of concern. No further mitigation measures were required for the residential handler.

The TRED adequately addressed potential exposure scenarios associated with the Canadian residential uses of trifluralin on ornamental gardens. The application rate, method of application and the formulation of the Canadian domestic product were encompassed by the American assessment. Thus, the conclusions derived from the TRED are considered applicable to the Canadian situation.

Residential Postapplication

In the United States, trifluralin is registered for use on turf, lawns, and vegetable and ornamental gardens. Postapplication cancer risks to adults from dermal exposure and non-cancer risks to toddlers from incidental oral, incidental soil ingestion and hand-to-mouth activities were assessed.

Based on the United States use pattern, potential postapplication exposures to adults and children in residential settings was assessed for the following scenarios:

- dermal exposure from residue on lawns (adult and toddler)
- dermal exposure from residue on golf course turfgrass (adult and youth)
- dermal exposure from residue on home gardens (adult and youth)
- hand-to-mouth transfer of residue on lawns (toddler)
- object-to-mouth transfer of residues on lawns (toddler)
- incidental ingestion of soil from pesticide-treated residential areas (toddler)

Postapplication inhalation risk following outdoor application of trifluralin granules was considered negligible and was not of concern.

Chemical-specific data was used in the assessment of cancer risk to adults from dermal postapplication exposure and to assess non-cancer risk to toddlers from incidental oral, incidental soil ingestion and hand-to-mouth activities. Assumptions as specified in the 1997 USEPA *Standard Operating Procedures (SOPs) for Residential Exposure Assessments* were also used.

The short-term incidental oral endpoint of 10 mg/kg bw/day was used to estimate the potential risks to toddlers from hand-to-mouth exposure, object-to-mouth exposure and soil ingestion. MOEs from toddler exposure exceeded 110 000 and are not of concern.

Based on a transferable residue chemical-specific study, the USEPA concluded that the day after application, residues of trifluralin were not detectable. Postapplication cancer risk to adults was less than 1×10^{-6} and therefore not of concern.

The TRED adequately addressed potential postapplication exposure scenarios associated with the Canadian residential uses of trifluralin on ornamental gardens; thus, the conclusions are considered applicable to the Canadian situation.

3.1.2.2 Exposure From Food and Drinking Water

Toxicology endpoints and safety factors that were used in the USEPA assessment of dietary risks (food and water) are shown in Appendix II.

Acute dietary risk is calculated considering the highest ingestion of trifluralin that would be likely on any one day, and using food consumption and food residue values. A statistical analysis allows all possible combinations of consumption and residue levels to be combined to estimate a distribution of the amount of trifluralin residue that might be consumed in a day. A value representing the high end (99.9th percentile) of this distribution is compared to the acute reference dose (ARfD), which is the dose at which an individual could be exposed on any given day and expect no adverse health effects. When the expected intake of residues is less than the ARfD, then acute dietary exposure is considered acceptable. When effects are of concern for a particular population group, the value is expressed as an acute population adjusted dose (aPAD).

The acute dietary risk estimates were below the USEPA's level of concern at the 99.9th exposure percentile for females 13 to 49 years of age (<1% of the aPAD), the population group of concern.

Chronic dietary risk (food and water) is estimated by determining how much of a pesticide residue may be ingested with the daily diet and comparing this potential exposure to an acceptable daily intake, which is the dose at which an individual could be exposed over the course of a lifetime and expect no adverse health effects. The acceptable daily intake is referred to as the ADI in Canada, and in the RED, it is expressed as the chronic population adjusted dose (cPAD). The ADI is based on a relevant endpoint from toxicology studies and on safety factors protective of the most sensitive population group.

When evidence of carcinogenicity is identified for the active ingredient, a cancer potency factor (Q_1^*) is generated and used to estimate cancer risk. The product of the expected exposure and the cancer potency factor (Q_1^*) estimates the lifetime cancer risk as a probability. A lifetime cancer risk below 1 in 10^{-6} usually does not indicate an unacceptable risk for the general population when exposure occurs through pesticide residues in or on food and to otherwise unintentionally exposed persons.

Drinking water exposure to pesticides can occur through groundwater or surface water contamination. The USEPA summed the exposure expected from drinking water with the estimated exposure from food and reported that the chronic dietary risk (food and water) was below the level of concern for all populations (<1% of the cPAD).

Applying the Q_1^* of 5.79×10^{-3} $(mg/kg/day)^{-1}$ to the food and water exposure values resulted in cancer risk estimates of 1.64×10^{-7} (DEEM-FCID) and 1.13×10^{-7} (Lifeline), which were below the USEPA's level of concern.

The USEPA dietary risk assessment is considered relevant to the Canadian situation. For those uses registered in Canada but not in the United States, there was enough room in the American "risk cup" that these do not pose a dietary risk to the Canadian population.

3.1.2.3 Aggregate Risk Assessment

Aggregate risk combines the different routes of exposure to trifluralin (i.e. from food, water and residential exposures).

Acute and chronic aggregate risk assessments are usually comprised of contributions from food and drinking water exposures. Short-term aggregate risk assessments are comprised of contributions from food, drinking water and non-occupational exposure (dermal, inhalation).

Trifluralin use by the homeowner is very seasonal (mostly early spring) and this exposure would likely be acute (one day of golf) or short-term (multiple residential applications).

Aggregate short-term risk: The aggregate incidental oral exposure estimate for children on turf was combined with the estimated chronic dietary exposure for children 1 to 2 years old. The aggregate short-term MOE was much greater than the target MOE of 100; therefore, the risk was not of concern.

Aggregate cancer risk: For trifluralin, the chronic food exposure was added to drinking water exposure and estimated exposure from residential use. The Lifetime Average Daily Dose from residential use was negligible, and when added to the chronic dietary (food and water) exposure, the aggregate cancer risk was not of concern.

Overall, the Canadian scenarios were adequately addressed by the USEPA aggregate risk assessment. Therefore, the USEPA aggregate risk conclusions are considered applicable to the uses of trifluralin in Canada.

3.1.3 Cumulative Effects

The USEPA has not determined whether trifluralin has a common mechanism of toxicity with other substances or whether it shares a toxic metabolite produced by other substances. Therefore, it was assumed that trifluralin does not share a common mechanism of toxicity with other substances, and a cumulative risk assessment was not required.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

The physicochemical properties indicate that trifluralin is sparingly soluble in water, the vapour pressure indicates that trifluralin is volatile and Henry's law constant indicates that trifluralin is rapidly volatilized from moist soil and water surfaces. Trifluralin is stable to hydrolysis at environmentally relevant pHs, but is very prone to phototransformation in air and water but not in soil. Environmental fate data for trifluralin are summarized in Appendix III.

Laboratory aerobic biotransformation studies indicate that trifluralin is moderately persistent to persistent in soil. However, anaerobic soil biotransformation of trifluralin is faster than aerobic biotransformation, showing slight to moderate persistence under anaerobic conditions. Canadian

field dissipation studies indicate that trifluralin is moderately persistent to persistent under field conditions. When persistent, some carryover of residues in soil to the next season has been observed. Trifluralin is classified as non-persistent in laboratory aquatic aerobic biotransformation studies. Several transformation products, mainly minor, are formed in soil and aquatic systems, but their lack of accumulation over the years indicate that they are not persistent. The major transformation products are listed in Appendix III.

Adsorption/desorption and leaching studies indicate that trifluralin is strongly adsorbed to most soils and does not meet the criteria identifying it as a leacher. Water monitoring data from the United States and collected by Canadian federal and provincial government departments have shown detections in surface water but not in groundwater.

Trifluralin is highly volatile even after incorporation into the soil matrix. Volatility is in fact one of the main dissipation routes for trifluralin. Volatilization increases with increasing soil moisture levels, temperature and rainfall, and decreases with the organic matter content in soils.

Trifluralin has been detected in air and rain in agricultural and non-agricultural areas, confirming that trifluralin is transported away from application sites. Even though phototransformation of trifluralin in air and water is rapid, residues have been detected in air, precipitation (rain and snow) and fog in remote areas such as the Canadian Arctic, Greenland and the Bering Sea. These detections in remote regions may indicate that trifluralin sorbed to airborne particulate is more resistant to phototransformation, therefore allowing long-range transport to take place. The sorbed trifluralin is then deposited in dry or wet form to remote areas.

The log K_{ow} indicates trifluralin has the potential to bioaccumulate. The potential to bioaccumulate is supported from data conducted in both the laboratory and field for fish and aquatic invertebrates. However, loss of trifluralin from fish tissues is reportedly rapid.

4.2 Effects on Non-target Species

An assessment of environmental risk integrates the exposure and ecotoxicology data to estimate the potential for adverse ecological effects. Exposure is reflected in the calculation of initial and cumulative estimated environmental concentrations (EEC) in soil, water and wildlife food sources. These calculations are performed using the range of application rates selected from the supported uses.

A screening level risk assessment is initially performed using the EECs for a direct overspray scenario. The environmental risk is characterized using the quotient method. A risk quotient (RQ), which is the ratio of the EEC to the most sensitive endpoint, is determined. An RQ of one is the level of concern (LOC). If the screening level assessment indicates negligible risk (RQ less than one), then no further assessment is done. However, if the screening level assessment results in a potential risk (RQ equal to or greater than one), a refined assessment is undertaken for the organisms of concern. Refinement of the risk assessment takes into consideration more realistic exposure scenarios (e.g. drift to non-target habitats and runoff to water bodies) and may consider different toxicity endpoints. Data derived from monitoring studies may also be used in refining a risk assessment (Appendix IV).

4.2.1 Effects on Terrestrial Organisms

A risk assessment of trifluralin to terrestrial organisms was based on an evaluation of trifluralin toxicity data for earthworms (acute contact, reproductive), bees (acute oral and chronic), two species of birds (acute oral, dietary, and chronic), mammals (acute oral, dietary, and chronic), and terrestrial plants (vegetative vigour). A summary of terrestrial toxicity data for trifluralin is presented in Appendix V. For the risk assessment, the toxicity endpoints chosen from the most sensitive species were used as surrogates for the wide range of species that can be potentially exposed following treatment with trifluralin.

Trifluralin demonstrated no adverse toxicological effects on terrestrial invertebrates. Adverse effects were not observed in most bird studies except one chronic feeding study where cracked eggs were noted. Adverse effects were not readily apparent in most mammal studies. However, there were some effects on non-lethal parameters such as fetal body weights, parental weights and organ weights. As trifluralin is a herbicide, adverse effects to non-target terrestrial plants are expected. Vegetative vigour studies conducted with plants indicated that cucumber was the most sensitive plant when fresh weight or shoot height was assessed.

The screening level risk assessment indicated that exposure to trifluralin does not pose a risk to terrestrial invertebrates. A risk was determined for birds on an acute dietary basis (LOC exceeded by three times) and chronic basis (LOC exceeded by two times) at a maximum application rate of 4532 g a.i./ha. There was a risk determined for mammals on a chronic basis at all application rates (LOC exceeded by two to 11 times) but not on an acute dietary basis. Inhalation of trifluralin was deemed not to be a risk to birds or mammals. As would be expected, the herbicide trifluralin poses a risk to non-target terrestrial plants at most application rates (1152 to 4532 g a.i/ha). At 4532 g a.i./ha, the LOC was exceeded by five times. Appendix VI summarizes the assessment of the risk trifluralin poses to terrestrial organisms.

The risk assessment is conservative as it assumes that wild birds and small wild mammals are feeding exclusively in the treated area on 100% contaminated food sources. It also uses conservative (i.e. maximum) estimates for concentrations on food items and does not take into consideration feeding preference or avoidance behaviour toward contaminated food, as these data are not currently available. It is unlikely that wild birds and small wild mammals will be exposed chronically because trifluralin is only applied once a year as a pre-emergence, pre-plant herbicide. This use pattern will result in limited exposure. In addition, given the high volatility and rapid phototransformation of unabsorbed trifluralin, it is unlikely that food sources will maintain residues of trifluralin. Nevertheless, based on the results of the screening scenario, further refinements were conducted to determine the risk resulting from trifluralin in drift. The refinements also included the risk to non-target terrestrial plants.

The refinement of the risk assessment was conducted taking into consideration the concentrations of trifluralin that could be present in terrestrial habitats directly adjacent to the application field through spray drift. Spray drift data for a medium American Society of Agricultural Engineers[3] (ASAE) droplet size, as is generally used in groundboom herbicide

[3] Now called the American Society of Agricultural and Biological Engineers.

applications, indicate that the maximum amount of spray that will drift one metre downwind from the point of application during spraying is 6%. Using this percent drift, the off-site EECs for trifluralin were recalculated. This information was used to determine risk from drift. The toxicology endpoints used to calculate risk quotients were the same as those used in the screening level assessment. Based on this method of refinement, risk quotients for non-target terrestrial plants, birds and mammals directly adjacent to the application field were below the level of concern for all application rates. Appendix VII summarizes the refined assessment of the risk trifluralin poses to non-target terrestrial plants, birds and small mammals.

4.2.2 Effects on Aquatic Organisms

Acute and chronic risk to aquatic organisms is based on an evaluation of toxicity data on trifluralin for freshwater invertebrates, freshwater fish, freshwater vascular plants and algae, amphibians, estuarine/marine invertebrates, fish and diatoms. A summary of aquatic toxicity data for trifluralin is presented in Appendix V. For the assessment of risk, toxicity endpoints chosen from the most sensitive species were used as surrogates for the wide range of species that can be potentially exposed following treatment with trifluralin.

Trifluralin is toxic to freshwater invertebrates and fish tested on both an acute and chronic basis. As expected, freshwater algae and plants also showed acute toxicity effects. Two toxicity tests for amphibians resulted in varying degrees of toxicity with one species showing high sensitivity and another showing slight sensitivity. Trifluralin is acutely toxic to estuarine and marine invertebrates and the fish species tested, with chronic effects on the latter. There were no results on chronic toxicity tests available for estuarine and marine invertebrates. Marine diatoms are also acutely sensitive to trifluralin.

The initial aquatic assessment conducted is a deterministic screening level risk assessment. This approach is conservative, and primarily designed to identify the taxonomic groups that are not at risk and/or the use scenarios that do not pose an unacceptable risk. The screening level EEC is a conservative exposure estimate determined as the concentration resulting from a direct application to a 15 or 80 cm depth of water. The endpoint used for acute toxicity is half the lethal concentration to 50%LC_{50} for invertebrates and 1/10th of the LC_{50} for fish. The NOEC is used for chronic toxicity for both aquatic invertebrates and fish. If the NOEC is not available, 1/10th of the appropriate LC_{50} is used. If the RQ from this analysis is less than one, then it can be concluded that there is negligible risk and no further refinement is necessary. The screening level risk assessment showed that the RQs for all freshwater and estuarine/marine taxa for all applications of trifluralin are greater than one (Appendix VIII), indicating that further refinement is necessary. Therefore, a refined risk assessment was conducted to determine the risk associated with drift and runoff.

As with the terrestrial assessment, the value of 6% as the maximum amount of spray that will drift one metre downwind from the point of application was used to recalculate the off-site EECs for trifluralin. This information was used to determine exposure from drift in a 15 or 80 cm deep

water body adjacent to applications of trifluralin by groundboom equipment. The toxicology endpoints used to calculate risk quotients were the same as those used in the screening level assessment. Appendix IX summarizes the refined risk assessment from trifluralin concentrations predicted in drift.

Freshwater aquatic invertebrates are at a negligible risk of acute effects from drift at application rates less than or equal to 2016 g a.i./ha, but there is a risk to these organisms at application rates of 4500 and 4532 g a.i./ha. The level of concern for freshwater invertebrates on a chronic basis was exceeded at all application rates, indicating a risk from drift, although by a lower amount.

Freshwater fish and amphibians adjacent to the site of trifluralin application continue to be at risk, although at a reduced level on both an acute and chronic basis, at all trifluralin application rates.

Freshwater algae remained at risk from drift, but to a lesser extent, at all application rates. Freshwater vascular plants continued to be at risk only at application rates greater than or equal to 2016 g a.i./ha.

The risk to estuarine and marine invertebrates was reduced to negligible at all application rates.

Estuarine and marine fish continued to be at risk of acute effects, only at application rates greater than or equal to 4500 g a.i./ha. The level of concern for estuarine and marine fish was still exceeded, but by a decreased amount, on a chronic basis at all application rates of trifluralin, indicating a risk from drift.

Estuarine and marine diatoms were determined to be at risk only at application rates greater than or equal to 2016 g a.i./ha (Appendix IX).

Aquatic organisms can also be exposed to trifluralin from foliar applications as a result of runoff into a body of water. The linked models PRZM (Pesticide Root Zone Model) and EXAMS (Exposure Analysis Modeling System) were used to predict estimated environmental concentrations (EECs) resulting from runoff of trifluralin following application.

The models were run at application rates used for canola, asparagus and soybeans. Time-averaged EECs based on the appropriate time periods were used to calculate the risk quotients, e.g. 96 hours for acute endpoints and 21 days for chronic endpoints. The toxicology endpoints used were the same as those used in the screening level and refined drift risk assessments. Appendix X summarizes the refined risk assessment of potential exposure from trifluralin concentrations predicted in runoff.

The assessment showed that freshwater invertebrates are at negligible risk of acute and chronic effects from exposure to concentrations of trifluralin in runoff following all modelled applications.

Freshwater fish are at risk of acute and chronic effects from exposure to concentrations of trifluralin in runoff following all modelled applications. The LOC was exceeded by up to six times.

Amphibians are at negligible risk of acute effects from exposure to concentrations of trifluralin in runoff following applications modelled in the British Columbia, Prairie and Ontario/Quebec regions. Amphibians are at a low level of risk on an acute basis to concentrations of trifluralin in runoff in the Atlantic scenario (LOC was exceeded by 1.2 times). On a chronic basis, amphibians are at risk from trifluralin concentrations in runoff in all modelled scenarios. The LOC was exceeded by up to 15 times.

Freshwater algae are at negligible risk of acute effects from exposure to concentrations of trifluralin in runoff following applications modelled in the British Columbia, Prairie and Ontario/Quebec regions. However, the LOC was exceeded by 1.3 times in the Atlantic scenario, indicating a potential risk. Freshwater vascular plants are at a negligible risk from trifluralin following all modelled applications.

Estuarine and marine invertebrates and fish are at negligible risk of acute effects from exposure to concentrations of trifluralin in runoff following all modelled applications. Estuarine and marine fish are at negligible risk of chronic effects from exposure to concentrations of trifluralin in runoff following applications modelled in the British Columbia and Ontario/Quebec regions. However, the LOC was exceeded by 1.4 times in the Atlantic scenario, indicating a potential risk there.

Estuarine and marine diatoms are at negligible risk of acute effects from exposure to concentrations of trifluralin in runoff following all modelled applications.

A refined risk assessment was also conducted using the acute and chronic concentrations determined through monitoring of trifluralin concentrations in freshwater aquatic systems. Risk quotients indicate that the level of concern was not exceeded for freshwater fish on an chronic basis, and aquatic invertebrates and amphibians on either an acute or chronic basis. The level of concern for freshwater fish was exceeded by 1.5 times on an acute basis, indicating that freshwater fish may be at some risk to concentrations of trifluralin detected in Canadian waters.

There is some uncertainty associated with predicting risk to biota from concentrations of trifluralin in Canadian surface waters. Risk associated with concentrations of trifluralin in Canadian surface waters may be underestimated due to the following: 1) monitoring may have not occurred at the time of the peak concentrations of trifluralin, 2) sampling in some of the studies was conducted during periods when trifluralin was not applied in Canada (i.e. October through March) and 3) trifluralin was analyzed in samples that were taken from non-trifluralin use areas. Appendix XI summarizes the refined risk assessment from trifluralin concentrations that were obtained from Canadian water monitoring.

4.2.3 Endocrine Disruption Potential

Although a number of agencies have included trifluralin in lists of suspected endocrine disruptors, there appears to be very little evidence of trifluralin acting as an endocrine disruptor. The European Food Safety Authority, the Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic and the USEPA all agree that based on currently available data, trifluralin does not meet the criteria for classification as an endocrine disruptor. The USEPA (2004) concluded the following.

> Based on currently available data, trifluralin does not appear to be an endocrine disruptor. However, when the appropriate screening and/or testing protocols being considered under the Agency's (USEPA) Endocrine Disruptor Screening Program have been developed, trifluralin may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

4.3 Risk Mitigation

The risk assessment of trifluralin indicates that there is a potential for adverse effects on non-target aquatic plants, algae, amphibians, fish and aquatic invertebrates. Birds and mammals are also at risk if trifluralin is directly oversprayed onto their feeding habitat. To reduce the effects of trifluralin in the environment, buffer zones and precautionary label statements are required. Appendix XII shows the model inputs used for buffer zone calculations. The proposed label amendments, including amendments to buffer zones, are listed in Appendix XIII.

Trifluralin was determined to volatilize and has been detected in air, rain and dry deposition in the prairie provinces and in remote northern regions. Volatilization of trifluralin is dependent upon soil temperature and soil moisture and incorporation. In order to reduce the amount of trifluralin entering the atmosphere via volatilization, it is recommended that applications on hot summer days be avoided and incorporation into the soil occur concurrently with application.

5.0 Toxic Substances Management Policy Considerations

Trifluralin was assessed in accordance with PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*. This policy puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key management objectives is virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances. Substances associated with the use of trifluralin were also considered, including microcontaminants in the technical product and formulants in the end-use products.

Trifuralin has been assessed for four criteria: bioaccumulation, persistence, *Canadian Environmental Protection Act* for CEPA-toxic or CEPA-equivalent and predominantly anthropogenic (source).

- The log K_{ow} of trifluralin ranges from 4.83 to 5.27, which overlaps the TSMP criterion of log K_{ow} ≥5.0. Bioconcentration factors of 2041×, 9586× and 5674× were determined in edible, nonedible and whole fish tissues, respectively, from bluegill sunfish (*Lepomis macrochirus*). Other bioconcentration factors estimated from field data in fish were as follows: sauger (*Stizostedion canadense*), 5800; shorthead redhorse *(Moxostoma macrolepidolum*), 2800; golden redhorse *(M. erthrurum*), 1800; and fathead minnow (*Pimephales promelas*), 6000. Most of these bioconcentration factor s / bioaccumulation factors exceed the TSMP criterion of ≥5000. However, in a laboratory bluegill sunfish bioaccumulation study, 86 to 88% of accumulated trifluralin depurated from the fish after 14 days. In addition, a study in rats showed that 80% of administered trifluralin was eliminated in feces and about 20% eliminated in the urine. Additional field data addressing bioaccumulation in biota are required.

- Trifluralin does meet the criteria for TSMP persistence in soil. The aerobic soil biotransformation (laboratory) $t_{1/2}$ is 81 to 356 days, which is above the TSMP Track 1 criteria of ≥182 days. Trifluralin has been detected in air and precipitation in remote regions in Canada. Therefore, it must meet the criteria for persistence in air even though the phototransformation half-life in air (25 min to 5 h) is below the TSMP Track 1 cut-off criterion for persistence (≥2 days).

- Based on an environmental risk assessment, trifluralin was found to enter the environment at levels that pose a risk to aquatic organisms, and therefore would be considered "CEPA-toxic Equivalent" under the *Canadian Environmental Protection Act.*

- By definition the majority of chemical pesticides are considered to arise from anthropogenic sources as they are manufactured and applied to the environment for pest control purposes. As such, trifluralin is considered to have met the criterion of being predominately anthropogenic.

6.0 OECD Status of Trifluralin

Canada is part of the Organisation for Economic Co-operation and Development (OECD), which includes 30 member countries and provides governments with a setting in which to discuss, develop and perfect economic and social policies. They compare experiences, share information and analyses, seek answers to common problems, and work to coordinate domestic and international policies to allow for consistency in practices across nations.

- Trifluralin use has been prohibited in Sweden, Denmark and Norway because of concerns regarding persistence and toxicity.

- Trifluralin has been prohibited in the European Union based on its toxicity to aquatic organisms, persistence in soil, potential for accumulation and potential for atmospheric long-range transport.

- As described earlier in this document, the United States (also an OECD member), conducted an assessment of the registration of all trifluralin uses in 1996 and concluded that uses of trifluralin as a pesticide do not result in unreasonable adverse effects to human health or the environment provided the risk-reduction measures recommended in the RED and TRED were implemented. The evaluation included occupational and environmental risk assessments. The PMRA's conclusions with respect to the environment and issues specific to Canada (TSMP) were based on an environmental assessment performed by the PMRA. The PMRA has not made a final determination of the status of trifluralin under the federal Toxic Substances Management Policy at this time. Additional field data addressing long-range transport and bioaccumulation are required to complete this assessment. New environmental risk-reduction measures are proposed for the labels of products containing trifluralin.

7.0 Proposed Regulatory Decision

The PMRA has determined that trifluralin is acceptable for continued registration with the implementation of the proposed risk-reduction measures. These measures are required to further protect human health and the environment. Canadian end-use product labels should be amended to include the label statements listed in Appendix XIII. A submission to implement label revisions will be required within 90 days of finalization of the re-evaluation decision.

8.0 Data Required as a Condition of Continued Registration

The following data are required as a condition of continued registration under section 12 of the *Pest Control Products Act*. The registrant of this active ingredient must provide these data within the timeline specified in the decision letter, which the PMRA will send to registrants of the technical grade active ingredient.

- DACO 9.6.6 Field data addressing the bioaccumulation of trifluralin in biota inhabiting the areas of use.

- DACO 8.6 Analysis of air, water, and biota in remote areas, e.g. the Arctic, to provide additional and more recent data on long-range transport and bioaccumulation of trifluralin.

These data will be used to make a final determination of the status of trifluralin under the TSMP.

9.0 Supporting Documentation

PMRA documents, such as Regulatory Directive DIR2001-03, and DACO tables can be found on our website at www.pmra-arla.gc.ca. PMRA documents are also available through the Pest Management Information Service. Phone: 1-800-267-6315 within Canada or 1-613-736-3799 outside Canada (long distance charges apply); fax: 613-736-3798; e-mail: pmra_infoserv@hc-sc.gc.ca.

The federal TSMP is available through Environment Canada's website at www.ec.gc.ca/toxics.

The USEPA documents for trifluralin are available on the USEPA Pesticide Reregistration Status page at www.epa.gov/pesticides/reregistration/status.htm.

The regulatory status for trifluralin in Sweden, Denmark and Norway can be found at www.pic.int/en/Circular/CIRC10EN.pdf.

European Union documents regarding the regulatory status for trifluralin can be found at http://ec.europa.eu/food/plant/protection/evaluation/stat_active_subs_3010_en.xls and

http://europa.eu.int/eur-lex/lex/Notice.do?val=456305:cs&lang=en&list=456305:cs,451338:cs,450110:cs,&pos=1&page=1&nbl=3&pgs=10&hwords=&checktexte=checkbox&visu=#texte.

List of Abbreviations

ADI	acceptable daily intake
a.i.	active ingredient
ARfD	acute reference dose
aPAD	acute population adjusted dose
ASAE	American Society of Agricultural Engineers
AST	aspartate aminotransferase
bw	body weight
CAS	Chemical Abstracts Service
cm	centimetre(s)
d	day(s)
DACO	data code
DEEM™	Dietary Exposure Evaluation Model
DER	Data Evaluation Report
DFR	dislodgeable foliar residue
DT_{50}	dissipation time to 50%
DWLOC	drinking water level of comparison
EEC	expected environmental concentration
EFED	Environmental Fate and Effects Division (USEPA)
EFSA	European Food Safety Authority
EP	end-use product
EXAMS	Exposure Analysis Modeling System
FCID	Food Commodity Intake Database
FQPA	*Food Quality Protection Act*
g	gram(s)
h	hour(s)
ha	hectare(s)
kg	kilogram(s)
K_{oc}	organic carbon partition coefficient
K_{ow}	*n*-octanol–water partition coefficient
L	litre(s)
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LDH	lactic dehydrogenase
LOAEL	lowest observed adverse effect level
LOD	limit of detection
LOEC	lowest observed effect concentration
LOEL	lowest observed effect level
m	metre(s)
m^3	metre(s) cubed
min	minute(s)
mg	milligram(s)
mm	millimetre(s)
MOE	margin of exposure
MRL	maximum residue limit
NOAEL	no observed adverse effect level

NOEC	no observed effect concentration
NOEL	no observed effect level
nm	nanometre(s)
OM	organic matter
PCPA	*Pest Control Products Act*
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
p*K*a	-log10 acid dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RED	Reregistration Eligibility Decision
REI	restricted-entry interval
RQ	risk quotient
SF	safety factor
TGAI	technical grade active ingredient
TRED	Tolerance Reassessment Eligibility Decision
TSMP	Toxic Substances Management Policy
UF	uncertainty factor
USEPA	United States Environmental Protection Agency

Appendix I Registered Products Containing Trifluralin as of 1 December 2007

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
12611	D	SCOTTS CANADA LTD.	GARDEN WEED PREVENTOR	GR	1.47%
14545	C	DOW AGROSCIENCES CANADA INC	TREFLAN QR5 GRANULAR HERBICIDE	GR	5%
17223	C	MAKHTESHIM AGAN OF NORTH AMERICA	TRIFLUREX 40 EC HERBICIDE	EC	412g/L
18602	T	MAKHTESHIM AGAN OF NORTH AMERICA	TRIFLUREX TRIFLURALIN TECHNICAL	SO	98%
18608	T	NUFARM AGRICULTURE INC	RIVAL TECHNICAL HERBICIDE	SO	95%
18612	C	NUFARM AGRICULTURE INC	RIVAL EMULSIFIABLE CONCENTRATE LIQUID HERBICIDE	EC	500g/L
18926	C	NUFARM AGRICULTURE INC	RIVAL 10G SUPERFLOW GRANULAR HERBICIDE	GR	10%
19521	C	GOWAN COMPANY, L.L.C	FORTRESS HERBICIDE	GR	4%
20434	T	DOW AGROSCIENCES CANADA INC	TRIFLURALIN TECHNICAL HERBICIDE	SO	96.3%
20836	C	DOW AGROSCIENCES CANADA INC	TREFLAN GRANULAR HERBICIDE	GR	5%
21522	C	MAKHTESHIM AGAN OF NORTH AMERICA	TRIFLURALIN 10G	GR	10
21742	C	DOW AGROSCIENCES CANADA INC	ADVANCE 10G HERBICIDE	GR	10
21967	C	UNITED AGRI PRODUCTS CANADA INC	BONANZA 400 LIQUID HERBICIDE	EC	400 g/L

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
22744	C	UNITED AGRI PRODUCTS CANADA INC	BONANZA 10GGRANULAR HERBICIDE	GR	10
23933	C	DOW AGROSCIENCES CANADA INC	TREFLAN EMULSIFIABLE CONCENTRATE	EC	480 g/L
25723	M	DOW AGROSCIENCES CANADA INC	TREFLAN 1.47% MANUFACTURING CONCENTRATE	GR	1.47
27180	D	SCOTTS CANADA LTD.	GARDEN WEED PREVENTER REFILL (MIRACLE GRO)	GR	1.47
28289	C	UNITED AGRI PRODUCTS CANADA INC	BONANZA 480 LIQUID HERBICIDE	EC	480 g/L
28477	C	FIBERWEB INC	BIOBARRIER ROOT CONTROL SYSTEM	IF	17.5%

SO = SOLID
EC = EMULSIFIABLE CONCENTRATE
GR = GRANULAR
IF = IMPREGNATED FABRIC

C = COMMERCIAL PRODUCT
D = DOMESTIC PRODUCT
M = MANUFACTURING CONCENTRATE
T = TECHNICAL

Appendix II Toxicological Endpoints for Trifluralin Health Risk Assessments

Exposure Scenario	Dose (mg/kg bw/day)	Study	UF/SF or MOE[a]
Acute dietary (general population including infants and children)	No appropriate single dose endpoint was found for this population subgroup		Residential—N/A
Acute dietary (females 13–49 years old)	NOAEL = 100 mg/kg bw/day ARfD = 1.0 mg/kg bw/day	Rat developmental study LOAEL of 40 mg/kg bw/day based on increased total litter resorptions	UF = 100 (10× for both interspecies and intraspecies variability)
	aPAD = 1.0 mg/kg/day SF of 1× for FQPA considerations		
Chronic dietary (all populations)	NOAEL = 2.4 mg/kg bw/day UF = 100 (10× for both intraspecies and interspecies variability) cred = 0.024 mg/kg bw/day	Chronic toxicity study (capsule) dog LOAEL = 40 mg/kg bw/day	FQPA SF = 1 cPAD = 0.024 mg/kg bw/day
Short-term incidental oral (1–30 days)	NOAEL = 10 mg/kg bw/day	Two-generation reproduction study—Rat LOAEL = 32.5 mg/kg bw/day based on decreased pup weight in both generations	Residential LOC: MOE = 100 Occupational—N/A
Short-term dermal (1–30 days)	No quantification required since there was no systemic toxicity at the limit dose in the dermal toxicity study. There are no developmental toxicity concerns. Since the sensitization risk cannot be quantified, the HIARC recommends that the products containing trifluralin should be labelled as a SENSITIZER and that human contact should be avoided.		
Short-term inhalation (1–30 days)	Inhalation study NOAEL = 81 mg/kg bw/day	30-day inhalation study—Rat LOAEL = 270 mg/kg bw/day based on increased methemoglobin and bilirubin in females and incidences of dyspnea and ruffled fur in males and females	Residential LOC: MOE = 100 Occupational LOC: MOE = 100

Exposure Scenario	Dose (mg/kg bw/day)	Study	UF/SF or MOE[a]
Intermediate-term incidental oral, dermal and inhalation (1–6 months)	NOAEL = 10 mg/kg bw/day (dermal absorption rate of 3%) (inhalation absorption rate of 100%)	Special urinalysis study—Rat LOAEL = 40mg/kg bw/day based on the presence of tubular cytoplasmic hyaline droplets; increased total protein, AST and LDH in the urine; albumin Alpha1-globulin and alpha2-globulin observed by urine electrophoresis; and increased urinary volume	Residential LOC: MOE = 100 Occupational—N/A
Long-term dermal and inhalation (>6 months)	Oral study NOAEL = 2.4 mg/kg bw/day (dermal absorption rate = 3% when appropriate) (inhalation absorption rate 100%)	Chronic toxicity (capsule)—Dog LOAEL = 40 mg/kg bw/day based on increased frequency of abnormal stool, decreased body weights and body weight gains and on decreased erythrocytes and hemoglobin and increased thrombocytes in males	Residential LOC: MOE = 100 Occupational LOC: MOE = 100
Cancer (dermal, inhalation) Occupational, RED 1996	$Q_1^* = 7.7 \times 10^{-3}$ (mg/kg bw/day)$^{-1}$ Group C (limited evidence of carcinogenicity)		
Cancer (oral, dermal, inhalation) Residential, TRED 2004	$Q_1^* = 5.79 \times 10^{-3}$ (mg/kg bw/day)$^{-1}$ Group C (limited evidence of carcinogenicity)		

[a] UF/SF refers to total of uncertainty and/or safety factors for dietary assessments. MOE refers to desired margin of exposure for occupational or residential assessments.

Appendix III Environmental Fate of Trifluralin

Study Type	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Abiotic Transformation					
Hydrolysis	Duration not reported 52°C pH 3–pH 9	Stable with extrapolated half-life over one year at 20°C	Not a major route of transformation under acidic and basic conditions	Not reported	EFSA 2005a
	32 d 25, 37 and 52°C pH 3, pH 6 and pH 9	Stable	Not a major route of transformation under acidic conditions	Not reported	Grover et al. 1997
	Duration not reported 50°C pH 4, pH 7 and pH 9	Half-life > 1 year	Not a major route of transformation under acidic and basic conditions	Not reported	Grover et al. 1997
Phototrans-formation—soil	Sandy loam	Irradiated half-life: 41 d Dark control half-life: 66 d	Not a major route of transformation	None	USEPA RED 1996
	Not reported	Irradiated half-life: >30 d Dark control half-life: >30 d		None	EFSA 2005a
	30 d	Irradiated half-life: 41 d		None	Grover et al. 1997
Phototrans-formation—water	pH 7	Irradiated half-life: 0.4 d Dark control half-life: 20 d	Major route of transformation	TR-15, TR-13 and 5-trifluoromethyl-3-nitro-1,2-benzene diamine	USEPA RED 1996
	Sterile buffer solution	Irradiated DT_{50}: 0.3 d Dark control DT_{50}: 20 d		TR-6, TR-15	EFSA 2005a
	Natural water	Irradiated DT_{50}: 0.05 d Dark control DT_{50}: 2 d		Not determined	EFSA 2005a

Study Type	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Phototrans-formation—air	Structural-activity relationships	5.3 h	Major route of transformation	Not reported	EFSA 2005a
	Estimated	4.6 h		Not reported	www.speclab.com/compound/c1582098.htm
	Reno Nevada	July: 25–60 min October: 182–193 min		Not reported	Mongar and Miller 1988, in Grover et al. 1997
Biotransformation					
Soil—aerobic	22°C; sandy loam, clay loam and loam soils; 364 d	Half-life: 189–201 d	Moderately persistent to persistent	None reported	USEPA RED 1996
	22°C, three soils, pH 4.9–7.0, clay 8.8–36%, OM 2.6–5.1%	Half-life: 81–356 d	Moderately persistent to persistent	None	EFSA 2005a
Soil—anaerobic	22°C; sandy loam, loam and clay loam soils; 60 d	Half-life: 25–59 d	Slightly to moderately persistent	TR-4	USEPA RED 1996
	22°C, three soils, pH 4.9–7.0, clay 8.8–36%, OM 2.6–5.1%, 60 d	Half-life: 23–54 d		TR-4	EFSA 2005a
Water/sediment—aerobic	20°C, two systems, pH 6.2–7.9 (water), loamy sand, clay loam sediments	Half-life water: 1–2 d Half-life sediment: 7–15 d Half-life whole system: 6–15 d	Non-persistent to slightly persistent	TR-4, TR-7, TR-14	EFSA 2005b

Study Type	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Mobility					
Adsorption/ desorption	25°C, four soils, pH 5.7–7.7, % OC 0.3–1.2	K_{oc}: 6414-13414	Immobile	Not reported	EFSA 2005b
	Five Saskatchewan soils	Mean K_{oc}: 7,296		Not reported	Grover et al. 1997
	11 Manitoba soils	Mean K_{oc}: 10,945		Not reported	Grover et al. 1997
Soil column leaching	No information	% recovered in leachate: 1.3	Immobile	None detected	EFSA 2005b
	No information	Not detected below 7.6 cm		Not reported	Grover et al. 1997
	Two soils, sandy and loam	% recovered in leachate: <1–2.6%		None detected	Grover et al. 1997
Volatility—laboratory	Loamy sand, surficial and incorporated, two moisture levels	Vapour losses greater at maximum retentive moisture capacity that field capacity total volatile loss was <9%		Not reported	Bardsley et al. 1969
	Sand soil, three moisture levels, three temperatures	Volatility increased with increasing soil moisture and temperature, <24% trifluralin volatilized			Parochettie and Hein 1973
	Dry and wet soils, two application rates, surficial and incorporated	All surface-applied trifluralin was volatilized in 24 h on wet soils, no volatilization on dry soils			Spencer and Claith 1974 in Grover et al. 1997
	Five temperatures, sandy loam soil	1.8 × increase in volatilization for each 10°C increase in temperature, 17 to 49% of applied was volatilized			Nash and Gish 1989

Study Type	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Volatility—field	Heavy clay, incorporated to 5 cm, 67 d	23.7% of applied was volatilized, losses correlated with rainfall		Not reported	Grover et al. 1988a
	Field application, 24 d	18% of applied volatilized			Smith et al. 1997
	Various, incorporated and surface applications	25 to 27% of applied volatilized in incorporated, 25 to 90% of surface applied volatilized			Grover et al. 1997
Field Studies					
Field dissipation	Canadian sites: Atlantic Canada Southern Ontario Prairie Provinces	Atlantic Canada half-life: 126 to >190 d Southern Ontario half-life: 63–173 d Prairie Provinces half-life: 99 d		None reported	Grover et al. 1997
		Total vapour loss was 24%, 85% of applied in top 7.5cm soil, 15% in 7.5–10 cm layer of soil			Grover et al. 1988
	Saskatchewan heavy clay	Carryover: 6–40% of applied			Grover 1995
	Canadian field				

Appendix IV Monitoring Data

Water Monitoring Data

A literature search for trifluralin water monitoring data in Canada revealed information from several monitoring studies indicating that trifluralin is present in Canadian surface water. In addition, water monitoring data for trifluralin were requested from provincial and territorial departments responsible for water quality monitoring. Requests were also submitted to Environment Canada, the Department of Fisheries and Oceans and the Health Canada Drinking Water Subcommittee. The information received through these requests was also considered in this assessment.

American databases were also searched for detections of trifluralin in water. Data on residues in water samples taken in the United States are important to consider in the Canadian ecoscenario water assessment, given the extensive monitoring programs in the United States. Surface water data for trifluralin were available from the United States Geological Survey National Water Quality Assessment program (NAWQA). Table 1 describes the monitoring results from these searches.

Table 1 Summary of the Monitoring Studies Available for Trifluralin

Data Source	Detection Frequency						Concentration Percentiles (µg/L) (analysis includes only data with detections)				
	Location		Minimum Detection or Detection Limit (µg/L)	Number of Systems Tested (or absolute number of samples)	Number of Systems or Samples with Detections	% Detection Frequency	Mean Detection (µg/L)	Median Value 50th	95th	Absolute Maximum	Arithmetic Mean including non-detects at ½ LOD
Wan et al. (2006)	Farm ditches in the Lower Fraser Valley, British Columbia 2003–2004	Transient ditches (average width of 0.25 m, average depth of 0.05 m), unfiltered water	0.02	29	7	24.1	0.070	N/A	N/A	0.19	N/A
		Permanent ditches (average width of 1.5 m, average depth of 0.5 m)	0.02	10	1	10.0	0.020	0.020	0.020	0.02	0.011
PMRA 1412281	Runoff	13 sites in the Okanagan, British Columbia (2005)	0.0000038–0.000028	26	1	3.8	0.000254	0.000254	0.000254	0.000254	0.000014
		Vancouver Island (2006)	0.0001, but low percent recovery of spiked samples (around 52%)	13	0	0					0.00005
PMRA 1412769	Upstream, downstream and at impacted sites on two creeks and one river in the Pacific region (2003–2004)		0	10	6	60.0	0.000003	0.000002	0.000004	0.000005	0.000002
PMRA 1413135	Surface water from the Pacific and Yukon Region (2003–2006) Pesticide Science Fund		0.0003-0.1	124	47	37.9	0.14	0.11	0.85	1.51	0.061
PMRA 1398447	Peel River, Yukon/Northwest Territories border (2002–2004)		0.1	2	0	0					0.050
PMRA 1398445	Slave River, Northwest Territories/Alberta border (2000–2003)		0.002-0005	5	0	0					0.001
Anderson (1995)	Alberta surface waters	Provincial database (1984–1989, 1993)	0.03-0.5	309	6	1.90	N/A	N/A	N/A	0.11	N/A
		Federal database (1974–1977, 1985–1993)	0.005-0.01	603	2	0.30	N/A	N/A	N/A	1.14	N/A

Data Source	Detection Frequency					Concentration Percentiles (µg/L) (analysis includes only data with detections)				
	Location		Minimum Detection or Detection Limit (µg/L)	Number of Systems Tested (or absolute number of samples)	Number of Systems or Samples with Detections	% Detection Frequency	Mean Detection (µg/L)	Median Value 50th	95th	Absolute Maximum	Arithmetic Mean including non-detects at ½ LOD
Anderson (2005)	Alberta surface waters (1995–2002)		0.005	3053	29	0.95	N/A	0.004	N/A	0.187	N/A
PMRA 1412731	Alberta surface waters (2002–2005)		0.005	1666	1	0.06	0.001	0.001	0.001	0.001	0.0025
Anderson et al. (1998)	Streams Alberta (1995–1996)		0.02	110	2	1.8	0.047	0.047	0.047	0.047	0.01
	Small lakes (1995–1996)		0.02	123	0	0.0					0.01
PMRA 1311107	Alberta reservoirs (2003–2005)		0.00515	59	0	0.00					0.0026
Wood and Anthony (1997)	Prairie springs (groundwater resources) 1991–1994		0.0004	142	0	0					0.0002
PMRA 1412740	Saskatchewan (1990–2006)		0.005–0.1	479	4	0.8	0.208	0.185	0.370	0.4	0.0256
PMRA 1412283	Ambient water in Manitoba (2001–2006)		0.03	510	0	0.000				0.00	0.015
PMRA 1311130	Manitoba (1995–2001)		0.03	911	0	0.00					0.015
Currie and Williamson (1995)	Surface waters in Manitoba (1972–1994)		0.005–0.03	1850	66	3.60	0.071	0.030	0.268	0.88	0.013
Grover et al. (1997)	Farm dugouts and ponds in the Canadian Prairies (1987–1989)	Spring 1988 and 1989	0.05	83	N/A	11	N/A	N/A	N/A	0.11	N/A
		Summer 1988	0.05	42	0	0					0.025
		Fall 1987 and 1988	0.05	70	N/A	3	N/A	N/A	N/A	0.08	N/A
Rawn et al. (1999)	Red River and tributaries in Southern Manitoba, 1993–1995	Assiniboine River	0.00002	32	N/A	61.0	0.00320	0.00210	N/A	0.00245	N/A
		LaSalle River	0.00002	32	N/A	71.0	0.00300	0.00017	N/A	0.0028	N/A
		Morris River	0.00002	31	N/A	84.0	0.00087	0.00038	N/A	0.00825	N/A
		Pembina River	0.00002	31	N/A	66.0	0.00026	0.00019	N/A	0.00229	N/A
		Rat River	0.00002	32	N/A	75.0	0.00037	0.00021	N/A	0.00214	N/A
		Roseau River	0.00002	32	N/A	59.4	0.00035	0.00017	N/A	0.00261	N/A
		Seine River	0.00002	32	N/A	63.0	0.00036	0.00019	N/A	0.00217	N/A
		Red River at Emerson	0.00002	31	N/A	84.0	0.00057	0.00049	N/A	0.0017	N/A
		Red River at Ste Agathe	0.00002	32	N/A	75.0	0.00074	0.00049	N/A	0.00326	N/A

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		Permanent ditches (average width of 1.5 m, average depth of 0.5 m)	0.02	10	1	10.0	0.020	0.020	0.020	0.02	0.011
PMRA 1412281	Runoff	13 sites in the Okanagan, British Columbia (2005)	0.0000038–0.000028	26	1	3.8	0.000254	0.000254	0.000254	0.000254	0.000014
		Vancouver Island (2006)	0.0001, but low percent recovery of spiked samples (around 52%)	13	0	0					0.00005
PMRA 1412769	Upstream, downstream and at impacted sites on two creeks and one river in the Pacific region (2003–2004)		0	10	6	60.0	0.000003	0.000002	0.000004	0.000005	0.000002
PMRA 1413135	Surface water from the Pacific and Yukon Region (2003–2006) Pesticide Science Fund		0.00034–0.1	124	47	37.9	0.14	0.11	0.85	1.51	0.061
PMRA 1398447	Peel River, Yukon/Northwest Territories border (2002–2004)		0.1	2	0	0					0.050
PMRA 1398445	Slave River, Northwest Territories/Alberta border (2000–2003)		0.002–0005	5	0	0					0.001
Anderson (1995)	Alberta surface waters	Provincial database (1984–1989, 1993)	0.03–0.5	309	6	1.90	N/A	N/A	N/A	0.11	N/A
		Federal database (1974–1977, 1985–1993)	0.005–0.01	603	2	0.30	N/A	N/A	N/A	1.14	N/A

Data Source	Detection Frequency					Concentration Percentiles (µg/L) (analysis includes only data with detections)				
	Location		Minimum Detection or Detection Limit (µg/L)	Number of Systems Tested (or absolute number of samples)	Number of Systems or Samples with Detections	% Detection Frequency	Mean Detection (µg/L)	Median Value 50th	95th	Absolute Maximum	Arithmetic Mean including non-detects at ½ LOD
Anderson (2005)	Alberta surface waters (1995–2002)		0.005	3053	29	0.95	N/A	0.004	N/A	0.187	N/A
PMRA 1412731	Alberta surface waters (2002–2005)		0.005	1666	1	0.06	0.001	0.001	0.001	0.001	0.0025
Anderson et al. (1998)	Streams Alberta (1995–1996)		0.02	110	2	1.8	0.047	0.047	0.047	0.047	0.01
	Small lakes (1995–1996)		0.02	123	0	0.0					0.01
PMRA 1311107	Alberta reservoirs (2003–2005)		0.00515	59	0	0.00					0.0026
Wood and Anthony (1997)	Prairie springs (groundwater resources) 1991–1994		0.0004	142	0	0					0.0002
PMRA 1412740	Saskatchewan (1990–2006)		0.005–0.1	479	4	0.8	0.208	0.185	0.370	0.4	0.0256
PMRA 1412283	Ambient water in Manitoba (2001–2006)		0.03	510	0	0.000				0.00	0.015
PMRA 1311130	Manitoba (1995–2001)		0.03	911	0	0.00					0.015
Currie and Williamson (1995)	Surface waters in Manitoba (1972–1994)		0.005–0.03	1850	66	3.60	0.071	0.030	0.268	0.88	0.013
Grover et al. (1997)	Farm dugouts and ponds in the Canadian Prairies (1987–1989)	Spring 1988 and 1989	0.05	83	N/A	11	N/A	N/A	N/A	0.11	N/A
		Summer 1988	0.05	42	0	0					0.025
		Fall 1987 and 1988	0.05	70	N/A	3	N/A	N/A	N/A	0.08	N/A
Rawn et al. (1999)	Red River and tributaries in Southern Manitoba, 1993–1995	Assiniboine River	0.00002	32	N/A	61.0	0.00320	0.00210	N/A	0.00245	N/A
		LaSalle River	0.00002	32	N/A	71.0	0.00300	0.00017	N/A	0.0028	N/A
		Morris River	0.00002	31	N/A	84.0	0.00087	0.00038	N/A	0.00825	N/A
		Pembina River	0.00002	31	N/A	66.0	0.00026	0.00019	N/A	0.00229	N/A
		Rat River	0.00002	32	N/A	75.0	0.00037	0.00021	N/A	0.00214	N/A
		Roseau River	0.00002	32	N/A	59.4	0.00035	0.00017	N/A	0.00261	N/A
		Seine River	0.00002	32	N/A	63.0	0.00036	0.00019	N/A	0.00217	N/A
		Red River at Emerson	0.00002	31	N/A	84.0	0.00057	0.00049	N/A	0.0017	N/A
		Red River at Ste Agathe	0.00002	32	N/A	75.0	0.00074	0.00049	N/A	0.00326	N/A

Data Source	Detection Frequency						Concentration Percentiles (µg/L) (analysis includes only data with detections)				
	Location		Minimum Detection or Detection Limit (µg/L)	Number of Systems Tested (or absolute number of samples)	Number of Systems or Samples with Detections	% Detection Frequency	Mean Detection (µg/L)	Median Value 50th	95th	Absolute Maximum	Arithmetic Mean including non-detects at ½ LOD
		Red River at Selkirk	0.00002	33	N/A	88.0	0.00063	0.00054	N/A	0.00226	N/A
Donald et al. (2001)	Wetlands in central Saskatchewan, June to July (1996–1998)	In wildlife habitat (no pesticide use)	0.01	16	N/A	19	0.004	0.001	N/A	0.020	N/A
		On farms with no pesticide use	0.01	25	N/A	20	0.012	0.001	N/A	0.200	N/A
		On farms with conventional tillage	0.01	24	N/A	4	0.007	0.001	N/A	0.100	N/A
		On farms with minimum tillage	0.01	27	N/A	15	0.009	0.001	N/A	0.158	N/A
Donald et al. (1999)	Wetlands in Northern Prairies after intense precipitation in late June to early July (1991–1994, 1996)		0.005	164	5	3.0	N/A	N/A	N/A	0.04	0.004
Jones et al. (1998)	Raw water from farm dugouts and recreational water bodies in southwestern Manitoba (1995)		0.03	127	1	0.8	0.110	0.110	0.110	0.11	0.016
PMRA 1311113	Wetlands in the Prairie region (2004) Pesticide Science Fund		0.00515	59	0	0					0.003
Struger et al. (1994)	Urban streams and storm water detention ponds, Ontario (1991)	Spencer Creek dry weather	0.005	3	0	0.0					0.0025
		Spencer Creek moderate to heavy rain events	0.005	6	0	0.0					0.0025
		Red Hill Creek dry weather	0.005	3	0	0.0					0.0025
		Red Hill Creek moderate to heavy rain events	0.005	7	3	43.0	0.006	N/A	N/A	N/A	0.004
		Wet pond at Fieldstone wet and dry events	0.005	4	1	25.0	0.006	0.006	0.006	0.006	0.003
		Dry pond at Brandt wet and dry events	0.005	4	0	0.0					0.0025

Data Source	Detection Frequency					Concentration Percentiles (µg/L) (analysis includes only data with detections)				
	Location	Minimum Detection or Detection Limit (µg/L)	Number of Systems Tested (or absolute number of samples)	Number of Systems or Samples with Detections	% Detection Frequency	Mean Detection (µg/L)	Median Value 50th	95th	Absolute Maximum	Arithmetic Mean including non-detects at ½ LOD
PMRA 1307560	Surface water in the Don and Humber River watersheds wet and dry events (1998–2002)	0.1	262	0	0.00					0.05
Giroux and Therrien (2005)	Effluent of seven municipal water treatment plants, Quebec (2001–2002)	0.03–0.05	193	0	0					0.019
	Samples of urban runoff from six rain events and three receiving water bodies, Quebec (2001)	0.03	24	0	0					0.015
Giroux (1998)	Ruisseau Corbin May to August (1997)	0.06	40	2	5	0.065	0.065	0.070	0.07	0.032
Giroux et al. (2006)	Chibouet River (2002–2004)	0.05	123	0	0.0					0.025
	Des Hurons River (2002–2004)	0.05	124	1	0.8	0.070	0.070	0.070	0.07	0.0254
	Saint-Régis River (2002–2004)	0.05	119	1	0.8	0.070	0.070	0.070	0.07	0.0254
	Saint-Zéphirin River (2002–2004)	0.05	120	0	0.0					0.025
Blomquist et al. (2001)	Raw water intake in the United States (1999–2000)	0.002	323	9	2.8	N/A	N/A	N/A	0.009	0.001
NAWQA (2006)	Surface water in the United States (1991–2005)	0.002–0.009	20591	3074	14.9	0.014	0.005	0.005	1.740	0.004
Hoffman et al. (2000)	Eight urban streams in the United States (1993–1994)	0.01	215	1	0.5	0.011	0.011	0.011	0.011	0.005

Appendix V Environmental Toxicity of Trifluralin

Organism	Study Type	Species	Endpoint	Value (effect)	Effect of Concern	Reference
Terrestrial Species						
Invertebrate	Acute oral	Honey bee (*Apis mellifera*)	LC_{50}	>50–>100 µg a.i./bee	Mortality	USEPA RED 1996
	Acute contact	Earthworm (*Eisenia foetida*)	LC_{50} technical LC_{50} formulated (4.8%)	>1000 mg a.i./kg soil > 480 mg a.i./kg soil	Mortality	EFSA 2005b
		Honey bee (*Apis mellifera*)	LD_{50}	>100 µg a.i./bee	Mortality	USEPA RED 1996
	Chronic	Earthworm (*Eisenia foetida*)	NOEC	>9.6–29 mg a.i./kg	Not described	EFSA 2005b
Birds	Acute oral	Bobwhite quail (*Colinus virginianus*)	LD_{50}	>2000 mg a.i./kg BW >2000–>2250 mg a.i./kg BW	Mortality	USEPA RED 1996 EFSA 2005b
		Mallard duck (*Anas platyrhynchos*)	LD_{50}	>2000 mg a.i./kg BW >2000 mg a.i./kg BW	Mortality	USEPA RED 1996 EFSA 2005b
	Dietary	Bobwhite quail (*Colinus virginianus*)	LC_{50}	>5000 mg a.i./kg diet 2974–>5620 mg a.i./kg diet	Mortality	USEPA RED 1996 EFSA 2005b
		Mallard duck (*Anas platyrhynchos*)	LC_{50}	>5000 mg a.i./kg diet >5000 - >6000 mg a.i./kg diet	Mortality	USEPA RED 1996 EFSA 2005b
	Reproduction	Bobwhite quail (*Colinus virginianus*)	NOEC	50 mg a.i./kg diet 452.3 mg a.i./kg diet	Reproduction	USEPA RED 1996
		Mallard duck (*Anas platyrhynchos*)	NOEC	50 mg a.i./kg diet 910 mg a.i./kg diet	Reproduction	

Organism	Study Type	Species	Endpoint	Value (effect)	Effect of Concern	Reference
Mammals	Acute oral	Rat	LD_{50} technical LD_{50} formulated	>5000 mg a.i./kg BW >919 mg a.i./kg BW	Mortality	USEPA RED 1996 EFSA 2005a, 2005b
	Dietary	Rat	90-d NOEC	50 mg a.i./kg diet	Urinary changes	
		Rat	2-year NOEC	2000 mg a.i./kg diet	No effects	
	Reproduction	Rat	NOEL maternal NOEL develop-mental	225 mg/kg bw/day 475 mg/kg bw/day	Weight gain Fetal body weight	
		Rat	NOEC (2-generation)	>2000 mg a.i./kg diet 200 mg a.i./kg diet	No effects Kidney weights	
Plants	Vegetative vigour		Shoot height EC_{25}	Fresh weight EC_{25}	Vegetative vigour	USEPA RED 1996
		Cucumber Corn Radish	897 1648 1049	892 1222 1379		
Freshwater Organisms						
Invertebrates	Acute—technical	*D. magna, D. pulex, Simocephalus, Gammarus fasciatus*	EC_{50} (96%)	245–2200 µg a.i./L	Mortality	USEPA RED 1996 EFSA 2005b
		Pteronaarcys sp.	LC_{50} (96%)	2800 µg a.i./L	Mortality	
		Palaemonetes kadiakensis	LC_{50} (96%)	37 µg a.i./L	Mortality	
Invertebrates	Acute—formulated	*Daphnia magna*	EC_{50} (48%)	299 µg a.i./L	Mortality	Stavola 2004
Invertebrates	Chronic	*Daphnia magna*	NOEC (97–99.9%)	2.4–50.7 µg a.i./L	Mortality	USEPA RED 1996
			LOEC (97%)	7.2 µg a.i./L	Mortality	

Organism	Study Type	Species	Endpoint	Value (effect)	Effect of Concern	Reference
Fish	Acute—technical	Bluegill sunfish (*Lepomis macrochirus*)	LC_{50} (96%)	8.4–89 µg a.i./L	Mortality	USEPA REDD 1996, Stavola 2004, EFSA 2005b
		Rainbow trout (*Oncorhynchus mykiss*)	96-h LC_{50} (96%)	22–88 µg a.i./L	Mortality	
		Fathead minnow (*Pimephales promelas*)	LC_{50} (96%)	105 µg a.i./L	Mortality	
		Channel catfish (*Ictalurus promelas*)	LC_{50} (96%)	210–2200 µg a.i./L	Mortality	
		Largemouth bass (*Micropterus samloides*)	LC_{50} (96%)	75 µg a.i./L	Mortality	
		Carp (*Cyprinus carpio*)	LC_{50} (99%)	45 µg a.i./L	Mortality	
Fish	Acute—formulated	Goldfish (*Carassius auratus*)	LC_{50} (46%)	145 µg a.i./L	Mortality	
		Rainbow trout (*Oncorhynchus mykiss*)	LC_{50} (46–48%)	10–205 µg a.i./L	Mortality	
Fish	Chronic	Rainbow trout (*Oncorhynchus mykiss*)	NOEC	1.14 µg a.i./L	Larval length	USEPA RED 1996
			LOEC	2.18 µg a.i./L		
		Fathead minnow (*Pimephales promelas*)	NOEC	1.9 µg a.i./L	Survival	Stavola 2004
			LOEC	5.1 µg a.i./L		
			NOEC	0.3 µg a.i./L	Spinal cord deformation	OSPAR Commission 2005
			LOEC	0.7 µg a.i./L		
			NOEC	3.2 µg a.i./L	Growth and survival	
		Carp (*Cyprinus carpio*)	NOEC	<5 µg a.i./L	Alkalinephosphatase, aspartate aminotransferase in kidney, gills and liver	Poleksić and Karan 1999
			LOEC	5 µg a.i./L		

Organism	Study Type	Species	Endpoint	Value (effect)	Effect of Concern	Reference
			NOEC	10 µg a.i./L	Alanin amino-transferase in kidney, gills and liver	
			LOEC	20 µg a.i./L		
			NOEC	5 µg a.i./L	Alanin amino-transferase in serum	
			LOEC	10 µg a.i./L		
Amphibians	Acute	Toad (*Bufo bufo japonicus*)	LC_{50}	14,000 µg a.i./L	Mortality	www.pesticideinfo.org/List_AquireAll.jsp?Species=764&offset=-1
		Fowler's toad (*Bufo woodhousei fowleri*)	LC_{50}	108–187 µg a.i./L	Mortality	
Freshwater algae	Acute	*Selenastrum capricornutum*	EC_{50} (TGAI) Formulated (48%)	7.52–129 µg a.i./L 178 µg a.i./L	Effects not provided	USEPA RED 1996, EFSA 2005b
		Navicula pelliculosa	EC_{50} (98%)	15.3 µg a.i./L		
		Anabaena flos-aquae	EC_{50} (98%)	>339 µg a.i./L		
Freshwater vascular plants	Chronic	*Lemna gibba*	14-d EC_{50} (95%)	43.5 µg a.i./L	Effects not provided	USEPA RED 1996
Estuarine/ marine invertebrates	Acute—technical	Bay mussel larvae (*Mytilus edulis*)	EC_{50} (99%)	96 µg a.i./L	Shell growth inhibition	USEPA RED 1996
			EC_{50} (99%)	240 µg a.i./L	Survival	
		Grass shrimp (*Palaemonetes pugio*)	LC_{50} (99%)	640 µg a.i./L	Not provided	
Estuarine/ marine invertebrates	Acute—formulated	Dungeness crab (*Cancer magister*)	LC_{50} (44.5%)	330 µg a.i./L	Not provided	Stavola 2004
Estuarine/ marine fish	Acute	Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50} (99%)	160–190 µg a.i./L	Mortality	USEPA RED 1996, Stavola 2004
Estuarine/ marine fish	Chronic	Sheepshead minnow (*Cyprinodon variegatus*)	166-d NOEC	1.3 µg a.i./L	Fecundity	OSPAR Commission 2005

Organism	Study Type	Species	Endpoint	Value (effect)	Effect of Concern	Reference
Estuarine/ marine diatom		*Skeletonema costatum*	LC_{50} NOEC	28 µg a.i./L 4.6 µg a.i./L	Mortality	USEPA RED 1996

Appendix VI Summary of Screening Level Risk Assessment of Trifluralin to Terrestrial Organisms

Organism	Exposure	Endpoint Reported	Minimum and Maximum Use Rate (g a.i./ha)	RQ[1]
Invertebrates				
Earthworm	Acute	NOEC = (LC_{50} > 1000 mg a.i./kg soil/10)	600	0.003
			4532	0.02
Honeybee	Acute contact	LD_{50} = 100 µg a.i./bee (112 kg a.i./ha)	600	0.0054
			4532	0.0405
Birds				
Bobwhite quail	Acute dietary	NOEC = 297.4 mg a.i./kg diet (1/10 LC_{50})	600	0.35
			4532	**2.67**
	Chronic	NOEC = 452.3 mg a.i./kg diet	600	0.23
			4532	**1.75**
Small bird	Inhalation	$LC_{50\ (rat)}$ = 4.7 mg a.i./L 1/10 $LC_{50\ (rat)}$	—	8.8×10^{-9} 8.8×10^{-8}
Mammals				
Rat	Dietary	LD_{50} = 500 mg a.i./kg diet	600	0.1
			4532	0.78
	Reproduction	1/10 LD_{50} = 200 mg a.i./kg diet	600	**1.51**
			4532	**11.4**
	Inhalation	$LC_{50\ (rat)}$ = 4.7 mg a.i./L	—	350 g rat: 4.5×10^{-9} Sensitive Species: 1.7×10^{-8}
		1/10 $LC_{50\ (rat)}$		350 g rat: 4.5×10^{-8} Sensitive Species: 1.7×10^{-7}
Plants				
Plants	Vegetative vigour (cucumber)	EC_{25} = 892 g ai/ha	600	0.67
			4532	**5.08**

[1] Bold font indicates LOC was exceeded.

Appendix VII Refined Risk Assessment of Trifluralin to Terrestrial Plants, Birds and Small Mammals Directly Adjacent to Application Field

Organism	Exposure	Endpoint	Minimum and Maximum Drift Rate* (g a.i./ha)	RQ
Plants	Vegetative vigour (cucumbers)	EC_{25} = 892 g a.i./ha	36	0.04
			271.9	0.31
Birds	Bobwhite quail (chronic, reproduction)	NOEC = 452.2 mg a.i./kg diet	36	0.02
			271.9	0.16
	Bobwhite quail (acute dietary)	1/10 LD_{50} = 297.4 mg a.i./kg diet	36	0.01
			271.9	0.11
Small Mammals	Rat (chronic)	NOEC = 200 mg a.i./kg diet	36	0.09
			271.9	0.69

* Based on drift of 6% for a default droplet size of medium (herbicides).

Appendix VIII Summary of Screening Level Risk Assessment of Trifluralin to Aquatic Organisms

Organism	Exposure	Species	Endpoint Reported (µg a.i./L)	Endpoint for Risk Assessment[1] (µg a.i./L)	Minimum and Maximum Use Rate (g ai/ha)	EEC[2] (mg a.i./L)	RQ[3]
Freshwater Species							
Invertebrate	Acute	*Palaemonetes kadiakensis*	LC_{50} = 37	18.5	600	0.075	**4.1**
					4532	0.567	**30.6**
	Chronic	*Daphnia magna*	NOEC = 2.4	2.4	600	0.075	**31**
					4532	0.567	**236**
Fish	Acute	Rainbow trout	LC_{50} = 8.4	0.84	600	0.075	**89**
					4532	0.567	**675**
	Chronic	Fathead minnow	NOEC = 0.3	0.3	600	0.075	**250**
					4532	0.567	**1890**
Algae	Acute	*Selenastrum capricornutum*	NOEC = 5.37	5.37	600	0.075	**19.9**
					4532	0.567	**151**
Plant	Acute	*Lemna gibba*	EC_{50} = 43.5	21.8	600	0.075	**3.4**
					4532	0.567	**26**
Amphibian	Acute	Fowler's toad	LC_{50} > 108	10.8	600	0.4	**37**
					4532	3.021	**280**
	Chronic	Fish early life cycle (surrogate)	NOEC = 0.3	0.3	600	0.4	**1333**
					4532	3.021	**10070**
Estuarine and Marine Species							
Invertebrates	Acute	*Mytilus edulis*	EC_{50} = 96	48	600	0.075	**1.6**
					4532	0.567	**12**
Fish	Acute	*Cyprinodon variegatus*	LC_{50} = 160	16	600	0.075	**4.7**
					4532	0.567	**35.4**
	Chronic	*Cyprinodon variegatus*	NOEC = 1.3	1.3	600	0.075	**58**
					4532	0.567	**436**

Organism	Exposure	Species	Endpoint Reported (µg a.i./L)	Endpoint for Risk Assessment[1] (µg a.i./L)	Minimum and Maximum Use Rate (g ai/ha)	EEC[2] (mg a.i./L)	RQ[3]
Diatom	Acute	*Skeletonema costatum*	LC_{50} = 28	14	600	0.075	**5.4**
					4532	0.567	**41**

1 Endpoints used in the acute exposure risk assessment are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two for aquatic invertebrates and plants, and by a factor of 10 for fish and amphibians.

2 EEC based on a 15 cm water body depth for amphibians and an 80 cm water depth for all other aquatic organisms.

3 Bold font indicates LOC was exceeded.

Appendix IX Refined Risk Assessment of Trifluralin to Aquatic Organisms from Spray Drift

Organism	Exposure	Species	Endpoint Reported (µg a.i./L)	Endpoint for Risk Assessment[1] (µg a.i./L)	Minimum and Maximum Drift Rate (g ai/ha)	Drift EEC[2] (mg a.i./L)	RQ[3]
Freshwater Species							
Invertebrate	Acute	*Palaemonetes kadiakensis*	LC_{50} = 37	18.5	36	4.5	0.24
					271.9	33.9	**1.83**
	Chronic	*Daphnia magna*	NOEC = 2.4	2.4	36	4.5	**1.88**
					271.9	33.9	**14.1**
Fish	Acute	Rainbow trout	LC_{50} = 8.4	0.84	36	4.5	**5.36**
					271.9	33.9	**40.4**
	Chronic	Rainbow trout	NOEC = 0.3	0.3	36	4.5	**15**
					271.9	33.9	**113**
Algae	Acute	*Selenastrum capricornutum*	NOEC = 5.37	5.37	36	4.5	**1.19**
					271.9	33.9	**9.02**
Plant	Acute	*Lemna gibba*	EC_{50} = 43.5	21.8	36	4.5	0.21
					271.9	33.9	**1.56**
Amphibian	Acute	Fowler's toad	LC_{50} >108	10.8	36	24	**2.22**
					271.9	181	**16.8**
	Chronic	Fish early life cycle (surrogate)	NOEC = 0.3	0.3	36	24	**80**
					271.9	181	**603**
Estuarine and Marine Species							
Invertebrates	Acute	*Mytilus edulis*	EC50 = 96	48	36	4.5	0.09
					271.9	33.9	0.71
Fish	Acute	*Cyprinodon variegatus*	LC_{50} = 160	16	36	4.5	0.28
					271.9	33.9	**2.12**
	Chronic	*Cyprinodon variegatus*	NOEC = 1.3	1.3	36	4.5	**3.46**
					271.9	33.9	**26.1**

Organism	Exposure	Species	Endpoint Reported (µg a.i./L)	Endpoint for Risk Assessment[1] (µg a.i./L)	Minimum and Maximum Drift Rate (g ai/ha)	Drift EEC[2] (mg a.i./L)	RQ[3]
Diatom	Acute	*Skeletonema costatum*	LC_{50} = 28	14	36	4.5	0.32
					271.9	33.9	**2.42**

1 Endpoints used in the acute exposure risk assessment are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two for aquatic invertebrates and plants, and by a factor of 10 for fish and amphibians.

2 EEC based on a 15 cm water body depth for amphibians and an 80 cm water depth for all other aquatic organisms.

3 Bold font indicates LOC was exceeded.

Appendix X Risk Assessment of Trifluralin for Aquatic Organisms from Predicted Runoff

Toxicity Endpoint	EEC (µg a.i./L)[1]	Endpoint (µg a.i./L)	RQ[2]
Invertebrates			
Acute		18.5	
British Columbia	1.333		0.07
Prairie	1.748		0.09
Ontario/Quebec	1.193		0.06
Atlantic	4.740		0.26
Chronic		2.4	
British Columbia	0.682		0.28
Prairie	0.585		0.24
Ontario/Quebec	0.578		0.24
Atlantic	1.836		0.77
Fish			
Acute		0.84	
British Columbia	1.333		**1.58**
Prairie	1.748		**2.08**
Ontario/Quebec	1.193		**1.42**
Atlantic	4.740		**5.64**
Chronic		0.3	
British Columbia	0.682		**2.27**
Prairie	0.585		**1.95**
Ontario/Quebec	0.578		**1.93**
Atlantic	1.836		**6.12**
Amphibians			
Acute		10.8	
British Columbia	3.561		0.33
Prairie	5.437		0.50
Ontario/Quebec	3.232		0.30
Atlantic	13.183		**1.22**
Chronic		0.3	
British Columbia	1.312		**4.37**
Prairie	1.371		**4.57**
Ontario/Quebec	1.210		**4.03**
Atlantic	4.393		**14.6**

Toxicity Endpoint	EEC (µg a.i./L)[1]	Endpoint (µg a.i./L)	RQ[2]
Algae			
Acute		3.76	
British Columbia	1.333		0.35
Prairie	1.748		0.46
Ontario/Quebec	1.193		0.32
Atlantic	4.740		**1.26**
Vascular Plants			
Acute		21.8	
British Columbia	1.333		0.06
Prairie	1.748		0.08
Ontario/Quebec	1.193		0.06
Atlantic	4.740		0.22
Estuarine and Marine Invertebrates			
Acute		48	
British Columbia	1.333		0.03
Prairie	1.748		0.04
Ontario/Quebec	1.193		0.03
Atlantic	4.740		0.10
Estuarine and Marine Fish			
Acute		16	
British Columbia	1.333		0.08
Prairie	1.748		0.11
Ontario/Quebec	1.193		0.07
Atlantic	4.740		0.30
Chronic		1.3	
British Columbia	0.682		0.53
Prairie	0.585		0.45
Ontario/Quebec	0.578		0.45
Atlantic	1.836		**1.41**
Estuarine and Marine Diatoms			
Acute		14	
British Columbia	1.333		0.10
Prairie	1.748		0.13
Ontario/Quebec	1.193		0.09
Atlantic	4.740		0.34

1 90th percentile of 96-h and 21-d runoff values for acute and chronic, respectively.
2 Bold font indicates LOC was exceeded.

Appendix XI Risk Assessment of Trifluralin for Aquatic Organisms from Concentrations Determined in Canadian Monitoring

Monitoring Concentrations (µg/L)		RQ Freshwater Fish[1]	RQ Amphibians	RQ Estuarine/Marine Fish
Acute	**1.23**	**1.461**	0.11	0.08
Chronic	**0.05**	0.17	0.17	0.04

[1] Bold font indicates LOC was exceeded.

Appendix XII Inputs to Buffer Zone Models for Trifluralin

Ground Use Data (from Canadian labels)				
Crop	**Formulation Type**	**Method of Application**	**Number of Applications**	**Maximum Application Rate (g a.i./ha)**
Fall-seeded wheat, rye and triticale grown in rotation with tobacco	EC	Field sprayer	1	600
Rutabaga, forage legumes, Saskatoon berries, carrots, peppers, strawberries, tomatoes, summer fallow followed by spring or durum wheat, white turnips, forage kale, forage rape, white lupins and first year apple, apricot, cherry, peach, plum and pear trees	EC	Field sprayer	1	1152
Brussels sprouts, cauliflower, crambe, sainfoin and sweet clover	EC	Field sprayer	1	1400
Alfalfa, beans (common, dry, kidney, black, lima), fababeans, snapbeans, peas, soybeans, sunflowers, lentils, barley and wheat, canola/rapeseed, triazine tolerant canola/rapeseed, flax, mustard and safflower	EC	Field sprayer	1	1751
Asparagus, broccoli and cabbage	EC	Field sprayer	1	2016
Woody and perennial ornamental planting and nursery stock (field and container grown), shelterbelts (American elm, caragan, green ash, Scotch pine, Siberian elm)	EC	Field sprayer	1	4532

Model Input Data for Aquatic Buffer Zones (from OSPAR Commission 2005)		
Half-life for aquatic buffer zones	Aerobic whole system	15 days
Most sensitive freshwater species	Fathead minnow	NOEC = 0.0003 mg/L
Most sensitive estuarine/marine species	Sheepshead minnow	NOEC = 0.0013 mg/L

Model Input Data for Terrestrial Buffer Zones (from 1996 RED)		
Half-life for terrestrial buffer zones	Soil degradation half-life	201 days
Most sensitive terrestrial plant species EC_{25} for vegetative vigour	Cucumber—vegetative vigour	EC_{25} = 892 g/ha

Appendix XIII Label Amendments for End-Use Products Containing Trifluralin

The label amendments presented below do not include all label requirements for individual end-use products, such as first aid statements, disposal statements, precautionary statements and supplementary protective equipment. Additional information on labels of currently registered products should not be removed unless it contradicts the above label statements.

A submission to request label revisions will be required within 90 days of finalization of the re-evaluation decision.

The labels of **commercial** end-use products in Canada must include the following statements to further protect workers.

I) Under **PRECAUTIONS**:

For all commercial end-use products with the exception of the product with Registration Number 19521, the following label statement is required:

> All handlers must wear a long-sleeved shirt and long pants. In addition, wear chemical-resistant gloves, during mixing/loading, repair and clean-up activities.

For the product with Registration Number 19521, the following label statement is required:

> All handlers must wear a long-sleeved shirt and long pants. In addition, wear chemical-resistant gloves, during mixing/loading, repair and clean up activities. Aerial mixers/loaders must also wear coveralls.

For all commercial end-use products, the following label statements are required:

> DO NOT enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours.
>
> POTENTIAL SKIN SENSITIZER (also on the **primary panel)**

II) Under **ENVIRONMENTAL HAZARDS**:

For all commercial products formulated as emulsifiable concentrate, the following label statement is required:

> TOXIC to aquatic organisms and non-target terrestrial plants. Observe buffer zones specified under DIRECTIONS FOR USE.

For all commercial end-use products, the following label statements are required:

To reduce runoff from treated areas into aquatic habitats, avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application of the product when heavy rain is forecast.

Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative strip between the treated area and the edge of the water body.

III) Under **DIRECTIONS FOR USE**:

For all commercial end-use products, the following label statements are required:

DO NOT apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Discard clothing or other absorbent materials that have been heavily contaminated with this product. DO NOT reuse them .

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

DO NOT apply this product directly to freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs, ditches and wetlands), estuaries or marine habitats.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

To minimize the release of trifluralin into the environment due to volatilization, trifluralin should only be applied on cool mornings and evenings when air temperatures are 15°C or lower. To further reduce volatilization to the atmosphere, incorporation into the soil should occur concurrently with application.

For all commercial products formulated as emulsifiable concentrate, the following label statements are required:

Field sprayer application: DO NOT apply during periods of dead calm. Avoid application of this product when winds are gusty. DO NOT apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE) medium classification. Boom height must be 60 cm or less above the crop or ground.

DO NOT apply by air.

Buffer zones:
Use of the following spray methods or equipment DO NOT require a buffer zone: hand-held or backpack sprayer, inter-row hooded sprayer, spot treatment, soil drench, and soil incorporation.

The buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive terrestrial habitats (such as grasslands, forested areas, shelterbelts, woodlots, hedgerows, rangelands, riparian areas and shrublands), sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Method of Application	Crop	Buffer Zones (metres) Required for the Protection of:				
		Freshwater Habitat of Depths:		Estuarine/Marine Habitats of Depths:		Terrestrial Habitat
		Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m	
Field sprayer*	Fall-seeded wheat, rye and triticale grown in rotation with tobacco	35	4	3	1	0
	Rutabaga, forage legumes, Saskatoon berries, carrots, peppers, strawberries, tomatoes, summer fallow followed by spring or durum wheat, white turnips, forage kale, forage rape, white lupins and first year apple, apricot, cherry, peach, plum and pear trees	55	5	4	2	1
	Brussels sprouts, cauliflower, crambe, sainfoin and sweet clover	70	10	5	2	1
	Alfalfa, beans (common, dry, kidney, black, lima), fababeans, snapbeans, peas, soybeans, sunflowers, lentils, barley and wheat, canola/rapeseed, triazine tolerant canola/rapeseed, flax, mustard and safflower	80	10	5	3	1
	Asparagus, broccoli and cabbage.	90	10	5	3	1
	Woody and perennial ornamental planting and nursery stock (field and container grown), shelterbelts (American elm, caragan, green ash, Scotch pine, Siberian elm)	120	20	15	5	1

* For field sprayer application, buffer zones can be reduced with the use of drift-reducing spray shields. When using a spray boom fitted with a full shield (shroud, curtain) that extends to the crop canopy, the labelled buffer zone can be reduced by 70%. When using a spray boom where individual nozzles are fitted with cone-shaped shields that are no more than 30 cm above the crop canopy, the labelled buffer zone can be reduced by 30%.

When a tank mixture is used, consult the labels of the tank-mix partners and observe the largest (most restrictive) buffer zone of the products involved in the tank mixture.

The labels of domestic end-use products in Canada must include the following statement in the **PRECAUTIONS** section to further protect residential handlers:

POTENTIAL SKIN SENSITIZER (also on the primary panel)

References

Information Considered for the Environmental Risk Assessment

Published Information Considered

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